Health & Safety

#1 NASA's Number One Priority for Decommissioning is the protection of the public, the workers & the environment.

NASA's Focus on Safety

NASA is committed to keeping workers safe throughout decommissioning. While radiation safety is a priority, experience from other decommissioning projects has shown that other safety issues are of primary concern. As is the case with any construction site or industrial setting, normal occupational hazards (large machinery, excessive heat, noise, chemicals, etc.) and workplace accidents such as trips, falls, and muscle strains, are the safety issues of most concern. NASA's advanced planning and attention to detail at every step help to eliminate potential workplace hazards and prevent accidents from happening.

Advanced Planning for Safety

Decommissioning is made up of many specially sequenced jobs. During a thorough Safety Review, NASA takes into consideration the steps involved in each upcoming job and accounts for every potential hazard.

Before any work begins, NASA prepares a detailed Work Execution Package. This package contains:

All of the Work Instructions to do that particular job. Example: getting item from point A to point B.

The Job Safety Analysis (JSA) - identifies potential hazards in advance and enables NASA to develop procedures to eliminate these hazards. Example: Industrial settings are often very loud. NASA provides personal noise dosimetry for hearing protection.

Radiation Work Permit (RWP) - if the JSA identifies a radiation hazard, the RWP identifies:

- What the radiation risks are
- What the exposure levels will be
- How to minimize radiation risks using engineering controls and personal protective equipment

Breathing zone sampling for task specific air contaminants is used to protect workers during work in a confined space.

Containment areas can get hot especially in the summer. Instruments like this measure the potential for heat stress on workers.

During pre-decommissioning, workers replaced ladders and installed stairways into the Reactor Facility quadrants to minimize the potential for falls.

Critical Lift Reviews are conducted to prepare cranes and their operators for safe operation.

For some jobs, the Radiation Work Permit will direct workers to wear full-face respirators in areas with airborne radioactivity.

Ongoing Training

NASA provides ongoing worker training and annual refresher courses to reinforce its commitment to safe workplace habits. These include:

- ✔ **Radiation safety**
- ✔ **Occupational Health and Safety Association (OSHA) Training**
- ✔ **Crane safety**
- ✔ **Electrical safety**
- ✔ **Confined space safety**
- ✔ **Dept. of Transportation Packaging, Labeling and Shipping of LLRW**
- ✔ **Specialized training for an upcoming job**

Radiation Safety Program

A Proactive Approach

NASA's comprehensive safety program addresses potential hazards in the workplace before any work begins.

Minimizing Exposures

ALARA

or As Low As Reasonably Achievable, is the industry standard and is at the heart of NASA's Radiation Safety Program. ALARA Reviews are performed in advance of the start of any job that has the potential for radiation exposure. NASA uses ALARA and other safety reviews to specify the engineering controls and personal protective equipment necessary to protect worker health and safety.

ALARA
As Low As
Reasonably Achievable

- Minimize radiation exposures to workers and others entering a controlled area; and
- Make deliberate efforts to reduce radiation exposures to as low as reasonably achievable taking into account social, technical, economic, practical and public policy considerations.

Workers are equipped with personal protective equipment including coveralls, boots, hardhats, gloves, hearing and eye protection, and full-face respirators when necessary.

Posted Areas

Radiation areas have been posted and are identified with signs that display the conventional radiation warning symbol and give specific information about entry requirements.

Exposure refers to the amount of radiation energy that reaches an object's surface (the worker's body) in a given time period. It can reach a worker through

Direct contact **or** By movement of radioactive substances through the air, soil, surface water or groundwater.

There are two types of potential exposure:

EXTERNAL occurs when radiation (a type of energy wave or particle) penetrates the body.

INTERNAL occurs when radioactive material like dust or liquid, referred to as loose contamination, is taken into the body through breaks in the skin or by eating, drinking or breathing.

Three types of radiation are present:

Radiation	Exposure Potential
Alpha radiation is made up of particles that include two neutrons and two protons each. Alpha radiation travels only a few inches in air. A sheet of paper or skin will block alpha radiation, but it is harmful if it is taken into the body through eating, drinking or breathing.	Internal if inhaled
Beta radiation particles are smaller, though they have more energy than alpha particles. Beta radiation can travel up to 12 to 15 feet in air and can penetrate skin. About an inch of shielding - glass, wood, plastic or metal - will stop most beta particles.	Internal; External only to skin & eyes
Gamma radiation is made up of energy waves similar to light or radio waves but with more energy. It can travel great distances and penetrate matter. Gamma radiation can damage the human body. Concrete or lead is typically used to shield people from gamma radiation.	Internal and External

Upfront Preventive Measures Are Key

safety

External

Minimizing External Dose

Every effort is made to keep a worker's external dose to a minimum and well below regulatory limits. There are three basic guidelines:

Time
The time a worker may spend in a radioactive environment is strictly limited.

Distance
A worker uses remote handling devices (cameras, rods, cranes) whenever possible.

Shielding
A worker is provided with personal protective equipment and radiation safety training.

Physical barriers are used. A shielded work platform will be constructed so that work can be performed from a remote location during reactor vessel segmentation.

To minimize their exposure, workers use remote tools whenever possible.

NASA monitors each worker's external dose using a dosimeter, which is worn on the body and measures external dose over time.

Internal

Minimizing Internal Dose

Every effort is made to keep a worker's internal dose to a minimum and well below regulatory limits. Some preventive measures include:

Engineering Controls
Process and local ventilation systems using HEPA (High Efficiency Particulate Air) filters to capture or contain dust.

Personal Protective Equipment
Respiratory protection

Protective clothing

Administrative Controls/Best work practices
No eating, drinking, smoking or application of cosmetics

Radiation Work Permit required

NASA performs a bioassay on each worker to determine the types and amounts of isotopes that are present in his body (from natural sources and from previous radiation work).

INITIAL
When hired, provides baseline

ANNUAL
Detects any change from baseline

EVENT
If a specific exposure occurs

FINAL
When worker leaves or decommissioning is complete

NASA tracks each worker's level to check for accumulated internal dose, if any, during decommissioning work.

The average annual cumulative dose (internal + external) will be well below the regulatory health protective limits.

well below